

A New Ablative Heat Shield Sensor Suite

Completed Technology Project (2012 - 2013)



Project Introduction

A new sensor suite is developed to measure performance of ablative thermal protection systems used in planetary entry vehicles for robotic and human exploration. The new sensor suite measures ablation of the thermal protection system under extreme heating encountered during planetary entry. The sensor technology is compatible with a variety of thermal protection materials, and is applicable over a wide range of entry conditions.

The project has developed a reliable sensor that measures recession of an ablative thermal protection system used by a planetary entry vehicle. The sensor prototype has been built and tested in an arc jet facility in a flight relevant environment. The sensor suite includes optical sensors that sense existence of ultraviolet emission from high temperature gases in front of the vehicle. As the surface of the thermal protection system recedes, it progressively exposes each sensor and provides timed locations of the moving ablation front. The sensor data does not rely on elaborate data analysis procedure which simplifies interpretation. The sensor suite can also be integrated in a sensor plug that can be readily embedded in a variety of thermal protection materials using proven installation procedures.

Using data from the sensor, it is envisioned that the design of entry systems will significantly improve by reducing mass of the thermal protection system. The thermal protection system accounts for 5-50% of the entry vehicle mass, depending on the mission, which could be traded for increased efficiency and performance. It is also likely that existing entry vehicle architectures (build-to-print systems) would realize benefits by pushing the flight envelope to more extreme conditions based on flight data acquired by this sensor suite.

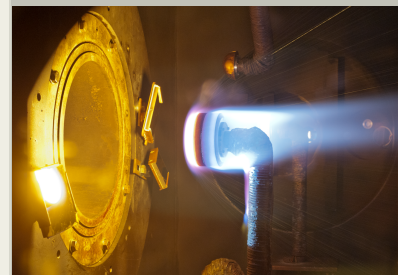
Anticipated Benefits

- Provides a means to acquire flight data for thermal protection system design of planetary entry vehicles
- Provides a means to acquire flight data to enable use of existing systems in more extreme environments with minimal risk
- Provides vehicle performance data (mass loss) during entry for atmosphere structure investigation (relevant for outer planets)

The technology can be used for several planetary entry missions including, but not limited to, Earth entries, Sample Return missions, and Mars, Venus, and Outer Planet entries.

As commercial space industry develops advanced spaceflight hardware, it will benefit from technologies such as this sensor suite in order to develop systems for more extreme return trajectories, and explore other planets.

The technology will have benefits for any entry missions that use ablative



Arc Jet Testing of the Sensor

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Ames Research Center (ARC)

Responsible Program:

Center Innovation Fund: ARC CIF

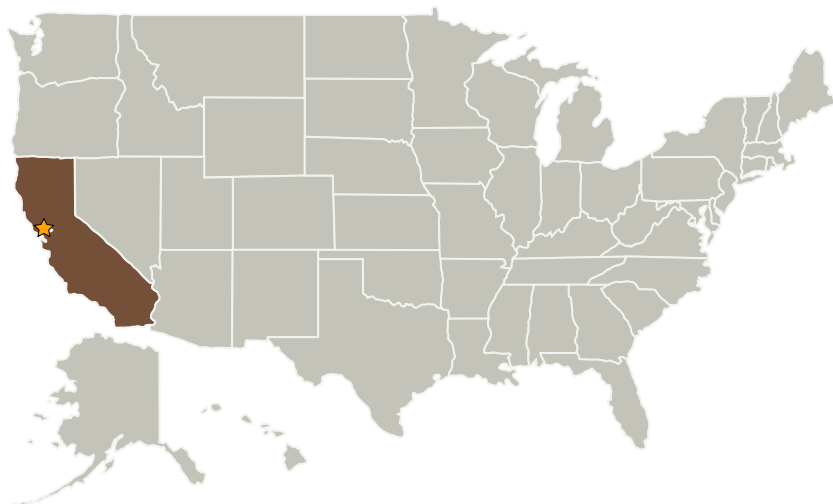
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thermal protection systems including the ones undertaken by the Department of Defense.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Ames Research Center(ARC)	Lead Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations

California

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Harry Partridge

Project Manager:

Deepak Bose

Principal Investigator:

Deepak Bose

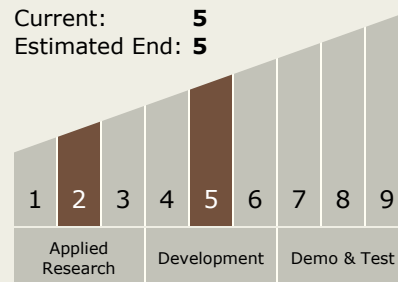
Co-Investigators:

Tomomi Oishi

Joseph G Mach

Technology Maturity (TRL)

Start: 2
Current: 5
Estimated End: 5



Technology Areas

Primary:

- TX02 Flight Computing and Avionics
 - TX02.1 Avionics Component Technologies

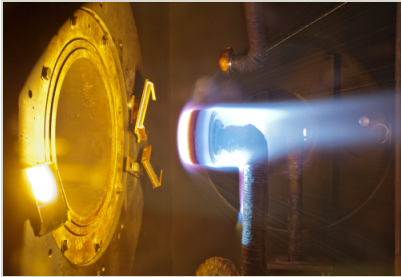
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Images



Arc Jet Testing of the Sensor

Arc Jet Testing of the Sensor

(<https://techport.nasa.gov/image/3075>)

Stories

1676 Review (17536)

(<https://techport.nasa.gov/file/8749>)

Technology Areas (cont.)

- └ TX02.1.2 Electronic Packaging and Implementations